After a confined female has deposited many or all of her eggs, she is killed or permitted to die and then preserved for identification. Usually unknown moths are killed after the female has deposited some of her eggs, especially species that do not place all of their eggs in one large cluster. This early killing usually produces satisfactory specimens for identification to species.

Meloid, chrysomelid and other beetles that visit and feed on flowers and plant parts in the field may produce eggs in confinement, especially if female beetles with distended abdomens are selected. Place one or more specimens of a given species in a medium to large sized salve tin possessing paper or plastic, or in a large, glass, cork-stoppered or cloth covered tube, 1″ x 5″, containing an inner plastic lining and plant parts, including flowers. Most of the eggs will be deposited on the paper, plastic lining or plant parts.

To avoid excessive condensation of moisture within the containers they should be kept in an environment where the daily temperature does not vary more than 5° F. This is also true for insects confined in plastic (polyethylene) bags. Confining beetles in plastic bags is unsatisfactory for many species will chew exit holes in the plastic.

Phytophagous species of Hemiptera, especially Pentatomidae, collected in spring or early summer are more apt to produce eggs in confiement than in the fall of the year. In Florida many terrestrial Hemiptera also produce eggs in the fall.

Females of many phytophagous and predacious terrestrial Hemiptera can be found on the host plants they infest, especially on growing terminals or flowers and fruits that are present. These may be collected by hand, in a large vial or with an aerial net. A sweeping net is also a useful tool for picking up inconspicuous sucking bugs on low-growing vegetation. Insects captured in the field may be sorted to species and placed immediately in oviposition containers. The author prefers to collect many kinds in a sweeping net and then transfer them to a screened, 12″ x 12″ x 12″, transporting container possessing a glass top and a long cloth sleeve attached to a large opening on one side. Upon returning to the laboratory, individuals of a given species are chosen and placed in deposition containers.

A pint or quart, glass, mason jar covered with gauze or paper toweling held in place by a metal screw ring, is a satisfactory oviposition container provided it possesses some white paper toweling, a piece of plastic and host plant material inserted in a vial containing water. Many pentatomids will live and produce eggs if the jar contains green or wax bean pods. The

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characteristic vertical and horizontal ridges. Noctuidae. *Leucania latiuscula* H.-S. 20± X.

Figure F.—A cluster of semi-transparent, flattened, disc-like, adhesive eggs on plastic showing embryos within. Pyralidae, species undetermined. 20± X.

Figure G.—A cluster of rose-colored, adhesive eggs of a pentatomid. Pentatomidae, *Mormidea pectiventris* Stal. 20± X.

Figure H.—A cluster of reddish-brown, adhesive, assassin bug eggs, possessing near-white fringes about their tops. Reduviidae, *Apiomerus crassipes* (Fab.). 20± X.

jars should be examined daily for eggs and fresh food replenished if needed.

Another useful cage for egg production by Hemiptera, especially terrestrial species, is a small flexible plastic bag, approximating 2.5″ x 4″ x 10″. Several bugs of a given species, plus one or two small pieces of white paper toweling and plant parts, are placed in an inflated bag and then the end is closed with a rubber band. Some terrestrial Hemiptera deposit more freely if they have access to special depository media. For example, species of *Leptocorixa* and spittle bugs deposit readily on or in dry grass and grain stems, *Zelus cervicalis* Stal. deposits on goldenrod flower parts, while milkweed bugs deposit in tight rolls of cellucotton or between compact layers of coarse cotton gauze.

An easy way to collect many night-flying moths and other insects is to use a "blacklight" lure adjacent to a vertical sheet of white canvas where the insects will assemble, or to use fermenting (sugaring) baits painted on tree trunks, fence posts and elsewhere which moths will visit at night and other insects during daylight hours.

Many large saturniid, citheronid and sphingid female moths caught outdoors will deposit some to many eggs if they are confined individually in glass quart jars resting on their sides and partially lined with paper toweling and closed with paper or cotton gauze. Some species deposit more abundantly if the jars contain host plant foliage and a water source. Before large females are introduced, their wings are cut off near their points of attachment. The absence of complete wings reduces decidedly the accumulation of scales on the eggs and the interior of the jar. Apparently lack of wings does not influence egg deposition.

Numberous medium-sized moths with wing lengths between three-fourths of an inch and one and one-half inches that come to lights or baits will produce eggs if they are enclosed individually in inflated small plastic bags approximating 2.5″ x 4″ x 10″ in size. In each bag include a small piece of white paper toweling and the foliage from some plant which will not curl upon drying. Laurel oak, live oak, magnolia and other leaves do not curl when dry. When leaves curl decidedly it is difficult to photograph the eggs deposited upon them. This method has produced eggs from several to many species among the Amatidae, Arctiidae, Geometridae, Lasiocampidae, Noctuidae, Olethreutidae, Pterophoridae, Pyralidae, Tortricidae and other families. Most of the confined females will deposit some or all of their eggs within forty-eight hours on the foliage, plastic bag or paper toweling, named in the usual order of preference. A few species deposit on leaves only, or plastic only.

Very small moths belonging to the above families and others with wing lengths under three-fourths of an inch will deposit eggs when confined individually in small 4- to 6-dram patent-lip vials. Each vial should contain an inner clear plastic lining on the side walls, a small leaf or a portion of a stiff leaf and a cork stopper. Most of the eggs will be deposited on the leaf or plastic lining.

During the course of an evening between 7 to 10 p.m. when the temperature is above 70° F., one may collect 25 or more species of moths at a "blacklight" lure. When a given species is abundant, a maximum of five vials is used with one moth in each vial. Within forty-eight hours one may

find no eggs in any of the five vials, or one vial with eggs, or two vials with eggs and occasionally all of the five vials with eggs. Complete absence of eggs may be due to the fact that a given species will not deposit eggs under the environment offered, or the females have already deposited their eggs, or copulation has not occurred, or the moths may be males. Sexes are not easy to determine, especially when they are placed in the vials under a weak light producing low visibility. Repeated tests with females of some species in vials or plastic bags have not produced eggs to date. An average night of collecting will produce 50 to 75 individual deposition containers. Usually within forty-eight hours one-third or more will show some to many eggs.

Mantispids will come to a white vertical cloth adjacent to a "blacklight" lure. The adults are sluggish and easy to capture in vials or plastic bags. Late in September and early in October 1959 at Gainesville, Florida, many adults, including representatives of three species, came to a white sheet adjacent to a "blacklight" which was located on the outskirts of town on the edge of an open field adjacent to a lot containing large deciduous trees. One night forty-five mantispids were captured and each was placed in an individual plastic bag containing a piece of moist paper toweling. Two of the three species captured deposited eggs on the interior of the plastic bag. All told, only five of the forty-five confined mantispids produced eggs. The mass distribution of these eggs closely resembled those found on foliage outdoors.

Egg Preservation.—Occasionally one is unable to photograph eggs immediately or before they hatch; consequently, it is desirable to preserve them for future use. If the eggs have a very firm outer covering which will not collapse or wrinkle after the embryo is dead and dry, then one may use heat to kill the eggs. The author has killed the embryos within eggs of mantids, katydids and walking sticks by placing them for a few minutes under an electric light located in a goose-neck lamp. The temperature range was 125 to 135° F. These eggs were killed without distorting the egg coat. This procedure for eggs of most insects produces collapsed and wrinkled eggs.

Eggs of insects may be killed and preserved in alcohol or formaldehyde solutions. In most solutions the inner tissues pull away from the outer covering and produce an abnormal appearance. The author has had good to fair results with the following mixtures for killing and preserving eggs. He uses most extensively a standard K.A.A. mixture diluted four or five times with ethyl or isopropyl alcohol. A standard K.A.A. mixture consists of commercial kerosene 1 part, acetic acid 2 parts, and ethyl or isopropyl alcohol 10 parts. For many eggs isopropyl alcohol in the K.A.A. solution produces the most satisfactory results. He also uses Kahle's fixing solution made with isopropyl alcohol in place of ethyl alcohol. Kahle's solution as used consists of isopropyl alcohol, 98 per cent—17 parts, formalin, 40 per cent—6 parts, glacial acetic acid—2 parts and distilled water—28 parts.

These solutions are not satisfactory for all eggs. Bright colors, waxy coatings and other surface characteristics of some eggs are apt to change upon standing in liquid preservatives. For most insect eggs it is best to photograph them when they are in a living state; however, some eggs when

killed and preserved in the above solutions will show external and internal features that cannot be seen in living eggs.

Eggs of different insects vary greatly in size, shape, color, adhesiveness and distribution. No attempt will be made to discuss these interesting facts. The illustrations present a few of them among common and unusual species. Eggs may be deposited singly and often in isolated places (Figures A and B)[2], while others occur in loose or dense clusters (Figures C, D, G and H). Most eggs have an adhesive coating on their exterior (Figures C, G and H). This seals them to their substrate and together when they are laid adjacent to each other. A few species produce eggs that are dry and usually nonadhesive (Figures B and E).

PHOTOGRAPHY.—The pictures of the eggs shown were taken on 35 mm. Kodachrome daylight or floodlight color film and transferred to black and white film to produce the illustrations. All of the illustrations on Plate I were made through one-half of a Bausch and Lomb stereoscopic microscope using the objective .66, 3.0 and 7.5 only. The camera used was a 35 mm. Kodak attached to a Leitz-Wetzler conical extension tube provided with a shutter, a side arm viewer and a ½ X magnifier which fitted into one ocular sleeve of a stereoscopic microscope. A Contax-D single lens reflex camera with a Kilfitt-Makro-Kilar D 1:2 lens was used when magnifications no greater than natural size were desired.

The requirements for taking photographs of insect eggs for the most part are the same as those required for good photography, especially portrait photography, namely, correct exposure, proper lighting, sharp focusing, position of the eggs and background color.

For correct exposure when using a Contax-D camera the author depended upon a Norwood Director Exposure Meter, Model M 2. To determine the correct exposure when taking pictures through a microscope with a fixed aperture camera a trial run was made on Kodachrome A film. The light source was a number 2 photoflood electric lamp located within a conical aluminum reflector placed ten inches above the object at approximately a 45° angle. The best exposures proved to be ½ to ¾ second through a .66 X objective, 1 to 1½ seconds through a 3.0 X objective and 3 to 5 seconds through a 7.5 objective. Dark-colored eggs usually required 50 percent more light than white or light-colored eggs.

An American Optical microscope spotlight was used for focusing. A few shots were taken with a spotlight alone, time 10 to 20+ seconds. The results were often very good except for color value. Most exposures tended to be somewhat red.

To obtain sharp focus when using the Leitz-Wetzler microscope camera requires considerable patience and repeated checking. Before focusing one must be certain that the cross-lines in the side arm viewer are equally black when using a specific eye. Your two eyes may vary in this respect. After this is established then one must proceed to focus on the object. Egg masses are not always perfectly level; also, when using objectives that give 10 X to 25 X magnification all parts of a given egg of most any size are not completely in focus. In other words the depth of focus is very narrow;

[2] These photographs were transferred from Kodachrome to black and white films by J. L. Messec.

consequently, one must decide what portion of an egg mass or a given egg is to be portrayed.

Position and background color are often very important for superior photographs. These can be determined by viewing and adjusting the eggs through both lenses of the steroscopic microscope before attaching the camera. The camera reveals what is seen, so it is up to the operator to make critical adjustments. In general, light-colored eggs should have a dark opaque background—black, deep green, blue or brown; while dark eggs show up best with a light opaque background—white, yellow or some other pale color. If black and white films are to be made from color transparencies it is best to confine background colors to white, greys or black. Background colors can be attained by placing opaque-colored paper on the microscope stage.

Shadows can be eliminated by placing the eggs on glass about one-inch above the background. The author uses the bottom side of a Syracuse watch glass stacked above another watch glass or on an inverted Petri dish. Reflections can usually be avoided by orienting the object or the light source.

In general, many eggs deposited on plastic or similar flexible products yield sharper and better photographs than those deposited on foliage, bark and elsewhere, chiefly because one may choose a suitable background. Reflections may be present when eggs are on plastic, especially if the plastic is old and wrinkled. For this reason it is best to use smooth plastic linings or new bags for oviposition. In case wrinkles occur in the plastic one can reduce or eliminate these by attaching one side of the cut piece of plastic bearing the eggs to the underside of a glass dish by Scotch tape and then sealing the other edges of the plastic piece to the glass dish after the surface is made smooth and taut. When eggs are deposited on plastic one can photograph their manner of attachment to the substrate by reversing the piece of plastic bearing the eggs. Also, when eggs are on plastic the developing embryos within the eggs can be seen, especially if one chooses transluscent, flat, disc- or scale-like eggs common among many species of the Olethreutidate, Tortricidae and Pyralidae. By using light reflected from a mirror below the eggs the embryos within stand out as u- or s-shaped bodies.

Conclusion.—When eggs of insects are available from field collecting or from captured females one can produce beautiful colored slides with a 35 mm. camera attached to a microscope. If the colored films are distinctly contrasty and have the necessary color combinations, they will produce good black and white negatives provided fine grained film is employed and developed in a suitable solution. These negatives, in turn, will yield excellent black and white pictures.

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A NEW SPECIES OF *OECANTHUS* FROM THE WEST INDIES (ORTHOPTERA, GRYLLIDAE)

T. J. WALKER [1]
and
ASHLEY B. GURNEY [2]

Because of similarities in the antennal markings, the only species of *Oecanthus* known from the West Indies is generally thought to be the snowy tree cricket (*Oecanthus niveus* of authors, not of De Geer).[3] Studies of the body and tegminal proportions, genitalia, and file, and descriptions of the song have convinced us that West Indian *Oecanthus* represent a species distinct from the snowy tree cricket. This new species is known only from the West Indies and has been collected on at least seven of the islands in the group.

Oecanthus allardi, new species

HOLOTYPE: Male; Christiansted, St. Croix, Virgin Islands, Oct. 1940, Harry A. Beatty, collector. Type No. 64826, U. S. National Museum.

Size, form, and background color (of dried specimens) similar to *O. quadripunctatus* Beutenmuller.

Basal segment of antenna with white swelling on inner edge of ventral face; swelling marked with black dot .16 mm. in diameter; slight infuscation at distal edge of swelling. Second antennal segment with ventral white swelling marked with a black ellipse .13 mm. long and .11 mm. wide. Except for tips of tibial spines, remainder of cricket without dark markings. Sensory area on terminal segment of maxillary palpus slightly more than half length of segment. Notch at apex of male genitalia as wide as deep (Fig. 1). Length of body 12.0, length of pronotum 2.0, caudal width of pronotal disk 2.0, length of tegmen 11.1, greatest tegminal width 4.7, length of hind femur 7.2 mm.

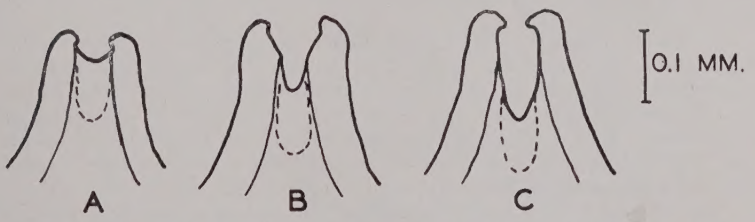

Fig. 1. Ventral view of apex of male genitalia. A. Holotype of *Oecanthus allardi*. B. Snowy tree cricket (*O. niveus* of authors), 8 mi. E. Padilla, Tamaulipas, Mexico. C. Snowy tree cricket, Erie County, Ohio.

ALLOTYPIC FEMALE: Same data and disposition as holotype. Color and markings as in holotype. Length of body 11.1, length of pronotum 2.0,

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caudal width of pronotal disk 1.8, length of tegmen 11.2, length of hind femur 7.6, length of ovipositor from bottom of mesal notch in subgenital plate 4.5 mm.

PARATYPES: 52 ♂♂, 54 ♀♀, 5 juv., as follows: Museum of Zoology, University of Michigan (75)—St. Croix, Virgin Islands: CHRISTIANSTED, Harry A. Beatty, Oct. 1940, 14 ♂♂, 9 ♀♀; Nov. 1940, 8 ♂♂, 4 ♀♀; Dec. 1940, 1 ♀; 1940, 3 ♂♂, 4 ♀♀; May 20, 1941, 4 ♂♂, 5 ♀♀. St. Thomas, Virgin Islands: s. side of island, Chester Roys, May 16, 1937, 1 ♀. St. Kitts, British West Indies: BASSETERRE, Chester Roys, May 24, 1937, 12 ♂♂, 8 ♀♀. Jamaica: LIGUANEA PLAIN, C. T. Brues, Nov.-Dec. 1911, 1 ♀. Puerto Rico: AGUIRRE, H. Osborn, Feb. 18, 1929, 1 ♀.

U. S. National Museum (33)—St. Croix, V. I.: C. E. Wilson, Feb. 1921, 1 ♀; near CHRISTIANSTED, Feb. 28, 1941, 1 ♀; H. A. Beatty, Sept. 1936, 2 ♂♂, 2 ♀♀, 2 juv. Puerto Rico: TALLABOA, July 23, 1914, 1 ♀; ENSENADA, June 14-19, 1915, 1 juv.; BOQUERON, L. C. Fife, Sept. 26, 1935, 1 ♂, 2 ♀♀; AGUIRRE, H. E. Box, Apr.-May, 1925, 3 ♂♂. Jamaica: 1 ♀; Jan. 25, 1920, 3 ♀♀; ST. ANDREW, Nov. 22, 1919, 1 ♀, Jan. 4-24, 1920, 1 ♀. Dominican Republic: CIUDAD TRUJILLO, H. A. Allard, Dec. 9, 1945, 1 ♀, Dec. 10, 1945, 1 ♀. Cuba: March 10, 1912, 2 ♀♀; CRISTO, ORIENTE, Oct. 3, 1913, 3 ♀♀; near VINALES, Sept. 16-22, 1913, 1 juv.; BARACOA, Aug. Busck, Sept. 1901, 1 ♂, Oct. 4, 1901, 2 ♂♂.

Academy of Natural Sciences of Philadelphia (3)—Jamaica: KINGSTON, Rehn & Hebard, July 4, 1920, 2 ♂♂, 1 juv.

There are several other West Indian records under the name *niveus*, as given in part by Ramos (1947, p. 11) for Mona Island, and by Rehn (1909, p. 222) for Cuba, which probably apply to *allardi*.

Two West Indian species questionably placed in *Oecanthus* by Kirby (1906, p. 75) were described as *Acheta crucis* Fabricius (1787, p. 232) from St. Croix, and *Acheta flavipes* Fabricius (1793, p. 30) from St. Thomas. It appears that neither of these species is correctly referred to *Oecanthus*.

This species is named in honor of Dr. Harry A. Allard, who suggested (1957) on the basis of the song that it might be distinct from the snowy tree cricket.

O. allardi is closely related to the snowy tree cricket and cannot be distinguished from it by the antennal markings. The males of *allardi* are distinct from those of the snowy tree cricket in their smaller size and more slender tegmina (Table 1). The apical lobes of the genitalia are separated by a notch with a depth of no more than one and one-half times the width. The males of the snowy tree cricket generally have a much deeper notch, but some Mexican specimens approach *allardi* in this respect (Fig. 1).

The structure of the stridulating file will separate *allardi* from most populations of snowy tree crickets. The file was examined by removing

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[3] The types of *Oecanthus niveus* (De Geer, 1773) (property of the Naturhistoriska Riksmuseum, Stockholm; examined by T. J. W.) belong to the species which previously has been called *Oecanthus angustipennis* Fitch, 1856, so that we regard *angustipennis* as a synonym of *niveus* (new synonymy). Therefore, the snowy tree cricket cannot correctly be called *niveus*. There are evidently at least two species of snowy tree crickets in the United States, and until the status of the West Coast species *O. rileyi* Baker, 1905, is clarified, no population of snowy tree cricket can be named with certainty.

TABLE 1.—Measurements of *Oecanthus allardi* Compared with Those of the Snowy Tree Cricket.*

	Length of Hind Femur	Length of Tegmen	Width of Tegmen	Tegmen Width/ Length
20 males of *allardi*,	6.5-8.1	11.0-12.7	4.7-5.3	.40-.43
St. Kitts and St. Croix	(7.1)	(11.9)	(4.9)	(.410)
10 males of snowy tree	7.8-9.0	12.2-13.7	5.7-6.4	.45-.48
cricket, Ohio	(8.4)	(13.3)	(6.2)	(.469)
10 males of snowy tree	7.4-8.4	12.9-14.3	5.8-6.6	.43-.50
cricket, Tamaulipas and	(8.0)	(13.7)	(6.3)	(.460)
Michoacan, Mexico				

* All measurements in millimeters; averages shown in parentheses.

the right tegmen and mounting it in Hoyer's medium, ventral surface up, on a microscope slide. The teeth were counted with the aid of a compound microscope, and the length of the file was measured from the mesal surface of the knob which is at the lateral end of the file to the mesal edge of the last file tooth. The file is usually gently curved at one or both ends, but the length was determined along a straight line parallel to the central portion of the file. In ten specimens of *allardi* from St. Croix and St. Kitts the file teeth numbered 40-44 (av. 42.0); the file length measured 1.56-1.78 (av. 1.66); the teeth/mm. (number of teeth/file length) figured 24.1-27.3 (av. 25.3). Snowy tree crickets from Honduras (4 specimens), Tamaulipas, Mexico (5 specimens), and eastern United States (13) had similar numbers of teeth, but the *maximum* teeth/mm. figure was 23.9. Only in snowy tree crickets from Oregon and California did all file characters overlap with those given for *allardi*. A series of five snowy tree crickets from Michoacan, Mexico, had only 29-33 file teeth.

The females of *allardi* usually may be separated from those of the snowy tree cricket by their smaller size. The lengths of the tegmina and of the hind femur are the most helpful measurements. The maximum length of the tegmina for *allardi* in the specimens at hand is 11.9, of the femur, 7.7 mm. Almost all females of the snowy tree cricket exceed these measurements.

Little has been reported of the biology of *allardi*. The holotype and allotype were collected "on bush." C. E. Wilson (1923a) recorded *allardi* (as *niveus*) on tobacco and stated that although individuals sometimes fed upon the leaves they were considered beneficial because they also fed upon plant lice. Wilson (1923b, p. 10) recorded *allardi* on cotton and described its eggs as laid in rows in the cotton stalk, "forming long scars." The snowy tree cricket of eastern United States lays eggs singly in the bark of trees, but Fulton's (1925) Race B of the West Coast deposits eggs in a manner similar to *allardi*. Allard (1957) found the species in weeds and stated that singing individuals were not localized in colonies as snowy tree crickets often are, but they were scattered.

Allard described the song of *allardi* as a "high-pitched, clear, tinkling chirp." It is a nighttime singer as is the snowy tree cricket, but its rate of chirping is much slower. At 70° F. it produces about 18 chirps per minute as compared to 135 chirps per minute for Ohio specimens of snowy tree cricket and 91 chirps per minute for Oregon specimens of Race B of the snowy tree cricket. In Allard's observations, the chirp rate of *allardi* varied from 16 at 66° to 22 at 77°.

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FIELD TESTS OF DUSTS AND SPRAYS AGAINST GERMAN COCKROACHES

G. S. Burden and J. L. Eastin [1]

The German cockroach [*Blattella germanica* (L.)] is becoming of increased concern because of its resistance to various chlorinated hydrocarbon insecticides as well as to pyrethrum (Heal *et al.*, 1953; Keller *et al.*, 1956a, b; Brown, 1958). Currently control is being achieved with several of the organophosphorus insecticides; however, this control is not equal to that experienced with chlordane, which at one time was the principal insecticide for combating this pest. Field strains of German cockroaches have not yet shown resistance to the organophosphorus insecticides, although there have been reports of unsatisfactory control in various localities. In recent laboratory experiments a colony was established that showed 4- to 11-fold resistance to malathion after selection with this material for 5 to 10 generations (Burden *et al.*, 1959). This resistance in a laboratory strain indicates that resistance is likely to develop in field strains.

During the last two years tests were conducted with dust and sprays against natural infestations in homes in Florida to evaluate the efficacy of several promising insecticides. In conjunction with these tests, and to survey the possible occurrence of resistance to organophosphorus insecticides, field strains of cockroaches were collected and tested in the laboratory by a standard technique on residues of malathion and Diazinon. Tests were also made on chlordane residues to ascertain the prevalence of resistance to this insecticide.

Tests in Homes

The following insecticides were tested in residual sprays against natural infestations in homes; 0.5% of Diazinon [*O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothiate], or Thiodan (6,7,8,9,10,10-hexachloro - 1,5,5*a*,6,9,9*a*-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide), 2% of dicapthon, Dipterex (*O,O*-dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate), malathion, or ronnel, and 5% of barthrin. With the exception of Dipterex, which was formulated with technical material, all the sprays were formulated with emulsifiable concentrates diluted with water. The insecticides that showed promise as residual sprays were also tested as dusts: 1% of Diazinon, and 4% of dicapthon, malathion, or ronnel in pyrophyllite. The sprays were applied as spot treatments with 2-gallon pressure sprayers fitted with Teejet No. 8002 flat spray tips and 1-quart pistol-type sprayers, and the dusts with plunger-type dusters and with polyethylene squeeze-bottle dusters fitted with extension nozzles. To eliminate as much variability as possible all treatments were made in a housing project consisting of ground-level duplexes of similar design that were constructed of concrete blocks. Pretreatment counts were made in the homes, noting all areas of cockroach infestations, and the percent reduction in live cockroaches was based on post-treatment counts made throughout a period of 89 to 90 days.

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[1] Entomology Research Division, Agricultural Research Service, U.S.D.A.

As indicated in Table 1, the best reduction was obtained with sprays of Diazinon, malathion, dicapthon, and ronnel. For the first 2 months the reduction was high with all four materials and after 3 months Diazinon was giving 99% and malathion 95% control. Dipterex, Thiodan, and barthrin were the least effective. The poor control with Thiodan, a chlorinated hydrocarbon, may have been due to cross-resistance, as laboratory tests indicated the cockroaches were moderately to highly resistant to chlordane. Diazinon dust gave good to fair control for 2 months, but was unsatisfactory after 3 months. The dicapthon and ronnel dusts gave good reductions the first 12 to 13 days, but gradually diminished in effectiveness, after that time. Control with malathion dust was never satisfactory.

TABLE 1.—Control of German Cockroaches in Homes with Several Insecticides Applied as Water-Base Sprays or Dusts.

Insecticide and percent concentration	Number of homes treated	Average pre-treatment count	Percent reduction after indicated days							
			5-6	12-13	22-23	29-30	36-37	43-44	61-62	89-90
Sprays										
Diazinon 0.5	8	275	99	99	97	98	98	97	95	99
Malathion 2	7	114	97	94	95	99	95	93	99	95
Dicapthon 2	6	144	97	94	99	99	99	97	96	82
Ronnel 2	7	296	94	90	94	95	93	97	94	86
Dipterex 2	7	232	75	87	91	93	92	93	82	76
Thiodan 0.5	7	107	87	81	80	81	88	92	94	85
Barthrin 5	3	267	84	95	53	41	27	3	—	—
Dusts										
Diazinon 1	3	463	94	92	94	91	89	92	87	77
Dicapthon 4	3	502	97	93	71	75	55	50	24	24
Ronnel 4	2	225	90	92	80	59	59	49	20	—
Malathion 4	3	217	53	26	—	—	—	—	—	—

A comparison of the results with these dusts and water-base sprays and those obtained with oil sprays by Lofgren *et al.* (1957) under similar conditions shows that the dusts were inferior to the sprays. The oil sprays, as well as the water sprays, exhibited a high degree of control at all times. In the homes treated with dusts it was observed that the cockroaches were

TABLE 2.—Range of LT-50's and LT-90's of German Cockroaches from Field-Collected Strains in Continuous Exposures to 10 mg. of Chlordane, Diazinon, or Malathion per Square Foot.

Insecticide	Number of strains	Range of lethal time (hours)		Average lethal time (hours) of normal colony		Percent of strains showing resistance*
		LT-50	LT-90	LT-50	LT-90	
Chlordane	36	3.62-132	4.3->700	3.8	4.6	75
Diazinon	29	0.4-0.92	0.43-1.03	0.58	0.73	0
Malathion	50	.5-2.8	.7-6.6	1.3	4.0	0

* Based on LT-50 ratios 3 times that of the normal colony.

avoiding the dusted areas and seeking areas where a dust could not be applied or would not adhere. This single factor could contribute to the inadequacy of the dusts as it is impossible to apply a dust to as many areas or surfaces as a residual spray. Certainly the more areas that can be treated, the greater the possibility of the cockroaches coming in contact with the treatment; consequently, better control will be obtained. Dusts drift well, however, and may be more effective than sprays for the treatment of hard-to-reach places such as the interiors of hollow walls.

Resistance Tests with Field Strains

To survey the level of resistance, male cockroaches from each field collection, or from small laboratory colonies established therefrom, were exposed continuously to residues of 10 mg. of chlordane, malathion, or Diazinon per square foot in pint glass jars by the method of Keller *et al.* (1956b). From the number dead or knocked down after various periods of exposure the time required to give 50% or 90% kill or knockdown (LT-50 or LT-90) was computed (Table 2). On the assumption that cockroaches exhibiting an LT-50 three times as great as normal are resistant, none of the field strains exhibited resistance to Diazinon or malathion, but 75% of the strains were moderately to highly resistant to chlordane, with LT-50's ranging up to 132 hours compared with 3.8 hours for the normal colony.

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TESTS WITH LARVICIDES FOR THE CONTROL OF HOUSE FLIES IN POULTRY HOUSES

H. G. Wilson and G. C. LaBrecque [1]

The problem of house fly control in poultry establishments has become more pressing in recent years, owing chiefly to two factors—the widespread development of resistance to nearly all insecticides, and the erection of large numbers of homes in the vicinity of many poultry establishments, resulting in demands from the occupants that adult flies, as well as objectionable odors, be eliminated. The problem is intensified in poultry houses where the laying flock, as well as the young chickens, are confined in individual screen cages about three feet above the ground. It is customary to allow the manure to collect for several months, and the cones that are formed under each cage soon reach a height of two or more feet. If the manure remains dry, there is little fly breeding, but when it becomes moist from leaking roofs or watering troughs, the house fly (*Musca domestica* L.) and a soldier fly (*Hermetia illucens* L.) become established. In a short time the larvae, especially *Hermetia*, break down and liquefy the entire cone, creating a serious fly problem and an extremely disagreeable odor.

A number of compounds, including Diazinon [*O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidinyl) phosphorothioate], that have been tested for use in poultry houses (Hoffman and Monroe, 1956; Wilson and LaBrecque, 1958) have recently shown signs of greatly decreased efficiency. Laboratory tests have confirmed the fact that resistance to most organic-phosphorus compounds, as well as chlorinated hydrocarbons, has reached such a high level that satisfactory control with the insecticides used heretofore is now extremely difficult.

Eight compounds were tested as larvicides against natural populations of house flies breeding in manure under caged poultry in the Orlando, Fla., area. The insecticides were applied at 150 to 1,000 mg. per square foot, in 1 to 4 gallons of spray or 2 to 3 pounds of dust or granules per 1,000 square feet. Larval density was evaluated by collecting a large spoonful of manure from 10 locations where the infestations appeared heaviest, spreading the material on a plywood board, and counting the larvae. The effectiveness of the treatments was determined by the difference in total counts made before and 1 to 14 days after treatment. The formulations used and the results obtained are shown in table 1. The dusts were made with pyrophyllite, except the dust of Baytex (*O, O*-dimethyl *O*-4-methylthio-*m*-tolyl phosphorothioate, Bayer 29493), which was made by diluting a 20% wettable powder with diatomaceous earth.

Baytex was effective at the lowest dosages, giving good control for 2-7 days at 150-300 mg./sq. ft. The other materials were ineffective at these dosages, but calcium arsenate gave good control for 3-4 days at 600-1,000 mg.

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[1] Entomology Research Division, Agricultural Research Service, U.S.D.A.

TABLE 1.—Control of House Fly Larvae in Poultry Houses with Various Insecticides.

Insecticide and Formulation		Dosage (mg./ sq. ft.)	Pretreatment count	Percent control after indicated days			
				1	2	3-4	7
Baytex*							
Kerosene solution	4%	300	>1,000	100	100	85	0**
	2%	150	240	100	94	100	100**
			610	99	100	94	92**
			513	99	100	89	85**
Granules	2%	150	475	100	100	68	0
Dust	2%	150	716	100	100	0	—
Calcium arsenate							
Suspension	6.6%	1,000	515	89	100	94	0
			427	96	99	95	0
			>1,000	99	99	100	0
			375	98	92	96	0
	4%	600	540	78	97	92	0
			>1,000	99	99	100	13
		300	>1,000	0	0	—	—
	2%	150	325	0	0	—	—
Kepone †							
Emulsion	4%	300	526	56	0	0	—
	2%	300	830	60	61	54	0
		150	367	26	0	0	—
			400	0	0	—	—
	1%	150	285	0	0	—	—
Dust	3%	300	810	52	49	69	0
	2%	300	650	74	94	92	0
		150	682	68	0	0	—
	1.5%	150	670	69	0	0	—
1-Naphthalene acetonitrile							
Kerosene solution	4%	300	570	77	65	0	0
	2%	300	940	80	75	64	0
	1.5%	150	150	0	0	—	—
	1%	150	560	73	64	0	0
2-(1-Naphthylmethyl)-2-thiopseudourea hydrochloride Ethanol (70%) solution	4%	300	643	0	0	—	—
	2%	300	810	48	0	0	—
	1.5%	150	950	68	0	0	—
	1%	150	830	51	0	0	—

TABLE 1.—Control of House Fly Larvae in Poultry Houses with Various Insecticides.—(Continued)

Insecticide and Formulation		Dosage (mg./ sq. ft.)	Pretreatment count	Percent control after indicated days			
				1	2	3-4	7
Phenothiazine							
Dust	2%	300	402	0	0	—	—
Polybor 3 ‡							
Dust	2%	300	748	0	0	—	—
Thiourea							
Dust	2%	300	535	0	0	—	—

* *O, O*-dimethyl *O*-4-methylthio-*m*-tolyl phosphorothioate, Bayer 29493.
** 0-20% control after 9-14 days.
† 2, 3, 3*a*, 4, 5, 6, 7, 7*a*, 8, 8-decachloro-3*a*, 4, 7, 7*a*-tetrahydro-4, 7-methano-indene-1-one.
‡ 98% disodium octaborate tetrahydrate.

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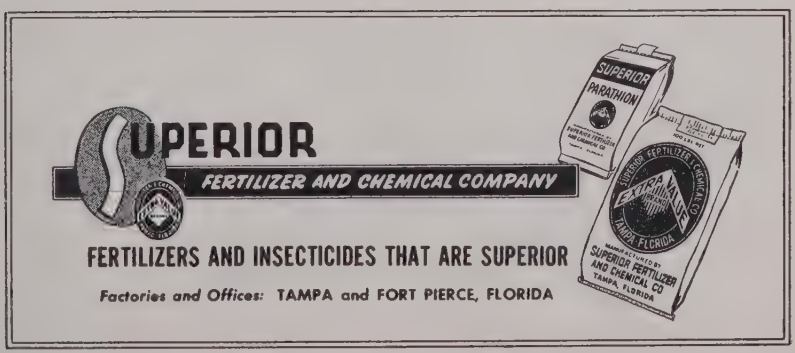

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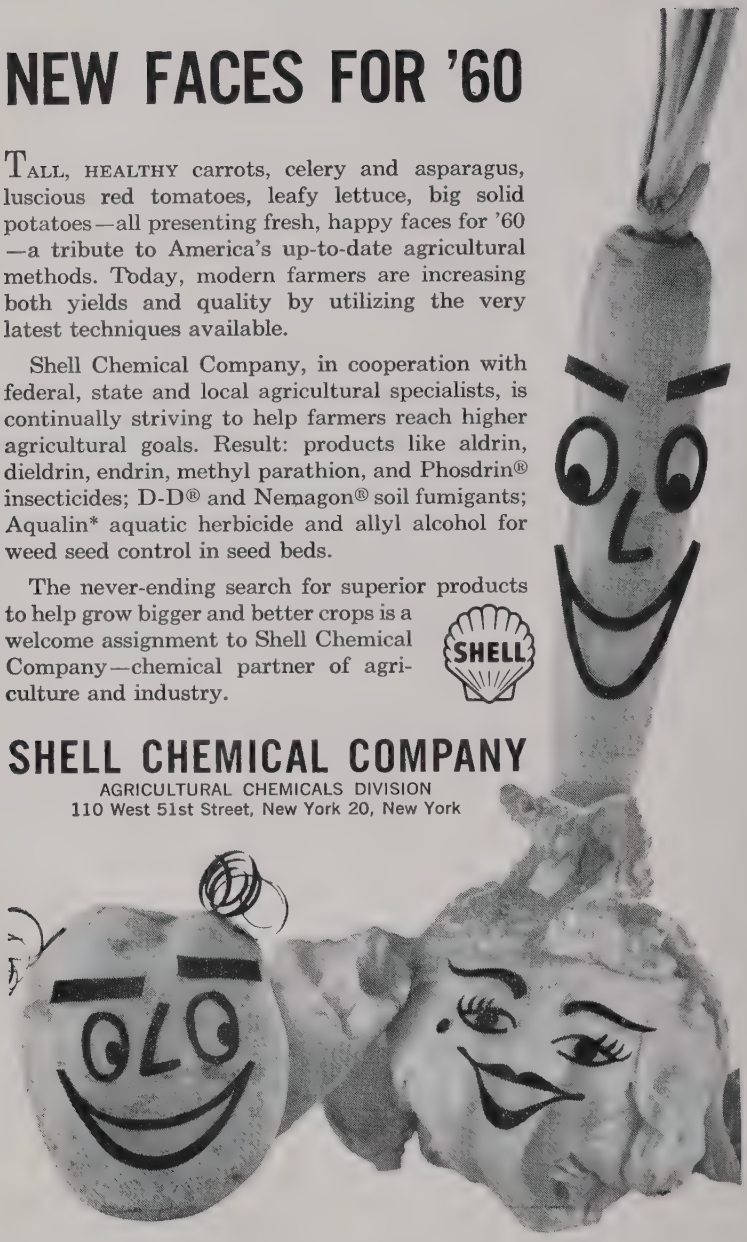

A NEW SPECIES OF *XENOTARSONEMUS* FROM FLORIDA [1]

ROBERT E. BEER [2]

At the moment of this writing, two described species of tarsonemid mites have been assigned to the genus *Xenotarsonemus* Beer. The genotype, *Tarsonemus viridis* Ewing is known only from a single collection, having been taken by F. F. Smith on strawberry in Maryland. Although Ewing (1939) reported the species from cyclamen in California, a study by the present writer of the single female involved has revealed its misidentification by Ewing. Thus, host associations of this species remain restricted to *Fragaria* sp. Whether or not it feeds on this host is still an unanswered question.

The second species in the genus is *Xenotarsonemus cadeae* Cromroy, which was described (Cromroy, 1958) from specimens taken on *Centrosema virginiana* (Leguminosae) in Puerto Rico. Again the host association may be of little significance in consideration of biological relationships of the species, since apparently only two mites (a male and a female) were collected. Because of the unusual taxonomic position occupied by members of this genus, reflecting the striking morphological modifications of the males, it will be of great interest to learn something of the biological relationships of members of the group. To date, such information has not come to light.

This paper describes a third species in the genus *Xenotarsonemus*. Specimens were taken on old leaves of the host plant that had patches of surface-growing fungi in considerable abundance, suggesting that it is a fungus-feeder. This, however, is to be regarded only as circumstantial evidence pointing to its possible feeding habits.

Xenotarsonemus denmarki, new species

MALE: Body short and robust, its greatest breadth at posterior extremities of coxae IV. Legs moderately robust, the anterior pairs largest, legs IV smallest. Ventral apodemes conspicuous and well-defined, the anterior margins of posterior apodemes uniting. Genital papilla large and conspicuous, slightly smaller than capitulum. Propodosmal dorsum projecting forward to cover only a small part of capitulum base. First three dorsal propodosomal setae arranged in a linear series, the pairs of the series diverging from first to third; fourth setae lateral to and slightly behind third; lengths of setae from one to four, 24, 19, 26, 35 microns. Anterior pair of dorsal hysterosomal setae 29μ long; inner setae of second series 42μ long, outer pair 24μ long; posterior dorsal hysterosomals 17μ long, the distance between them 21μ. First and second ventral propodosomal setae subequal in length, 9μ; distance between first pair, 18μ; second pair 26μ apart; setae of anterior and posterior pairs 5μ behind apodemes I and II respectively. First and second ventral hysterosomal setae subequal in length, 17μ; first pair situated 5μ behind transverse extension of apodemes III, second pair situated on apodemes IV at posterior third of apodemal length. Capitulum

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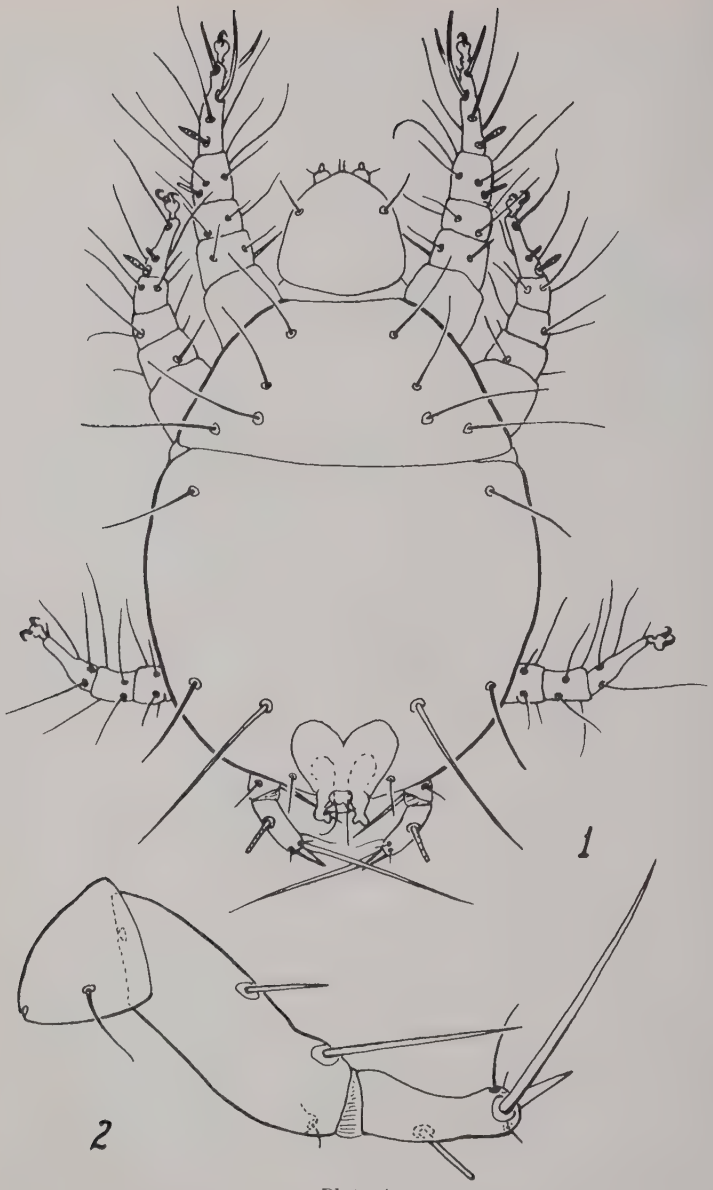

Plate 1

Fig. 1. *Xenotarsonemus denmarki* male, dorsal aspect; drawn from holotype.

Fig. 2. Leg IV of male *X. denmarki*, ventral aspect; drawn from paratype.

subcordate; 29μ long; greatest width at base, 31μ; dorsolateral seta 10μ long. Palpi short and robust with apices slightly dilated; apex adorned with a rounded knoblike projection and a short, blunt seta; base of palpus with a short ventral seta. Legs I and II stout, with terminal segment of conspicuously reduced diameter. Leg I with coxa slightly broader than long, without setae; femur one and one-half times as long as broad, with two ventral and one dorsal tactile setae; genu broader than long, with two dorsal and two ventral tactile setae; tibia slightly longer than broad, with two dorsal and three ventral tactile setae, one dorsal sensory peg near outer basal margin and one ventral sensory bristle near outer basal margin; tarsus three times as long as basal width, with two long, ventral, tactile setae near mid-segment and one stout, curved, ventral seta at outer apical margin, one long, dorsal tactile seta near mid-segment, one stout, curved, dorsal seta near inner margin at apical third, one stout, spikelike seta at outer apex, one peglike sensory seta located dorsally near outer basal margin; a stout curved claw subtended by a circular empodium and short pedicel adorn tip of tarsus. Leg II with coxa and femur similar in size and ornamentation to these segments in leg I; genu like genu I but with one dorsal and two ventral setae; tibia about as broad as long, with two dorsal and two ventral tactile setae; tarsus tapering abruptly from basal third to apex, nearly three times as long as broad at base, with two long, ventral, tactile setae at basal third of segment, one long, dorsal, tactile seta near outer apical margin, one large, dorsal, sensory peg located near outer basal margin, one small, dorsal, sensory peg near outer margin at basal third of segment; tarsus subtends a broad empodium and two stout, hooked claws. Leg III with coxa twice as long as broad, without ornamentation; femur nearly three times as long as broad, a slight constriction separating basifemur from telofemur, the latter about one half the length of the former; basifemur with one short, ventral, tactile seta; telofemur with two short, dorsal, tactile setae, one long and one short ventral tactile setae; genu with two long dorsal and two long ventral tactile setae; tibiotarsus tapering abruptly at basal third, about four times as long as broad at base, with one long ventral and two long dorsal tactile setae, one short, ventral, spinelike seta at apex of segment; tibiotarsus surmounted by a broad empodium and two stout, hooked claws. Leg IV with coxa subtriangular in shape, about one and one-half times as long as broad, with one ventral seta; femur with outer margin slightly convex, inner margin nearly straight, segment about three times as long as greatest breadth, the latter at mid-segment, with one short dorsal seta near outer apical margin, one stout ventral seta near inner margin at about mid-segment, its length slightly less than width of segment, one long, stout, ventral seta near inner margin just before apex, its length two and one-half times length of other ventral seta; tibiotarsus one half as long as femur, about two and one-half times as long as broad, inner margin slightly concave, outer margin slightly convex, apex of segment rounded and slightly dilated, with one rodlike sensory seta one half as long as segment located dorsally near outer margin at about mid-segment, two minute dorsal setae near apex of segment, one stout lanceolate seta projecting clawlike from tip of segment, one ventral tactile seta slightly longer than segment near inner apical margin, one stout ventral seta nearly three times as long as segment located near outer apical margin.

Plate 2

Fig. 3. *Xenotarsonemus denmarki*, ventral aspect of male; drawn from holotype.

Measurements of mite as follows: Tips of palpi to apex of genital papilla, 180μ; anterior margin of propodosomal dorsum to apex of genital papilla, 144μ; anterior margin of propodosomal dorsum to main body suture, 51μ; greatest width (at coxae III), 199μ; width at main body suture, 102μ.

Holotype male, Hillsborough River State Park, Florida, March 25, 1959, R. E. Beer, *Quercus niger*.

Paratypes: Two males with same data as holotype.

Location of Types: Snow Entomological Museum, The University of Kansas, Lawrence, Kansas.

The most conspicuous differences between this species and the two other members of the genus are to be found in the size and location of the dorsal propodosomal setae, the absence of spurlike or irregular projections on the inner margin of femur IV, and the chaetotaxy of leg IV.

While collecting this species, female specimens of three different, undescribed tarsonemid mites as well as females of *Fungitarsonemus peregrinus* (Beer) were also taken. Due to the uncertainty in associating the proper female with the male described above, a description of the female of *Xenotarsonemus denmarki* has necessarily been omitted from this paper.

The above species has been named to honor Mr. Harold A. Denmark, chief entomologist for the State Plant Board of Florida. This is a token expression of gratitude for several years of valuable assistance rendered to the Kansas group of acarologists by Mr. Denmark.

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FIELD EXPERIENCE ON SOME NEW MITICIDES DURING THE PAST TWELVE MONTHS ON CITRUS IN FLORIDA [1]

J. T. Griffiths [2]

The advent of several new miticides has required a re-evaluation of how best to control rust mites and red spiders on citrus in Florida. The problem is concerned with which program or material will be the most effective and which will be the most economical. Because of prolonged control, the most expensive material per pound may actually be the cheapest in terms of cost per acre.

During the past several years, Eloise Groves Association has made an effort to compare different miticides at different rates and under different circumstances in order to better acquaint ourselves with the most advantageous way of handling these miticides in the field. The discussion presented below is concerned with some specific experiments as well as with results in general field practice on something over 5,000 acres of citrus grove.

Rust Mite Control

The author reported at this meeting a year ago that, although Zineb might completely replace wettable sulfur and/or liquid lime sulfur, there was some indication that combinations of wettable sulfur and Zineb might be effective at certain times of the year, and that sulfur alone might still be the miticide of choice in the fall and winter months. During the past twelve months, most of the groves in this organization have been sprayed only twice, at post-bloom time and again during June or July. Miticides for red spider control were used in only about 20% of the groves during the fall and winter months, and applications for rust mite or scale control were made only where necessary. Wettable sulfur only, Zineb-sulfur, and zineb only gave quite satisfactory control when applied from November through February, and only one application was necessitated during that period in any one grove. Many of the properties were actually unsprayed between the time of the June or July scalicide in 1958 and the post-bloom spray in the spring of 1959.

At the post-bloom application in 1959, most of the groves in this organization were sprayed with Zineb only, but a few groves had copper included in the spray, and a few were sprayed with combinations of wettable sulfur and Zineb. The only groves in which rust mites appeared in large numbers in June, prior to the time for the application of the summer scalicide, were those sprayed with Zineb-sulfur or copper-Zineb. In these groves the summer spray of oil-parathion-Zineb was applied approximately a week early, and the amount of Zineb was increased by 50%-100% in order to compensate for the high rust mite infestations.

On bearing groves, all summer sprays contained oil, parathion, and Zineb, and were applied at one mile per hour with a Speed Sprayer. Model 36 sprayers were used with a single head, and Model 40 sprayers with a double head application. Zineb was used at rates of 5-6 pounds per acre

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[1] A paper presented at the 42nd Annual Meeting of the Florida Entomological Society, Miami, September 10-12, 1959.

[2] General Manager, Eloise Groves Association, Winter Haven, Florida.

TABLE 1.—Results from Differential Miticides Applied December 26, 1959 in 3-Year-Old, Pineapple-Orange Block at Rates of 2½ Gallons per Tree.*

		% Citrus Red Mite			Amount % Spider Injury †	% Rust Mites	
		Feb. 2	Feb. 25	May 20	May 20	Feb. 25	May 20
Kelthane-Wet. Sul.	5 pt. - 50 lb.	2	7	20	1.5	1	38
Kelthane-Zineb	5 pt. - 3 lb.	0	3	19	1.3	0	41
Tedion-Wet. Sul.	2½ lb. - 50 lb.	2	3	13	1.6	6	79
Tedion-Zineb	2½ lb. - 3 lb.	2	2	15	1.3	2	66
Trithion	1 qt. -	1	3	9	1.4	5	79
Trithion-Zineb	1 pt. - 3 lb.	1	3	15	1.3	2	54
Wettable Sulfur	- 50 lb.	24	46	6	2.1	7	78
Zineb	3 lb.	24	48	4	2.1	2	51
DN-Zineb	3⅓ - 3 lb.	7	18**	11**	2.0	1	19

* 65% rust, 5% p.m. and 30% Texas mites when sprayed.
** High populations not corrected between these dates.
† Graded 1 (none) ; 2 (some) ; 3 (severe, as judged by etching or graying of the foliage). No mesophyll collapse was present.

on most mature oranges and graepfruit, 3 pounds per acre on 10 to 15-year-old trees, and at the rate of 3 pounds per 500 gallon tank on trees that were sprayed by hand. In all instances where known rust mite populations were high at the time of the scalicide application, Zineb concentration was increased. As of September 1st, only 30 acres of red grapefruit out of a total of 5,000 acres of citrus have had to be resprayed, and rust mite populations are generally at a low level. This is a better record than was obtained in either of the last two years. In 1958, failures in August were related to the presence of high rust mite infestations at the time of the summer spray. It appears that an increase in the Zineb concentration alleviated this problem.

In December of 1958, an experiment was set up in a 3-year-old Pineapple orange block to compare several miticide combinations. These mixtures and the results from their use are shown in Table 1. Kelthane, Tedion, Trithion and DN were compared. Kelthane and Tedion were used with both wettable sulfur and Zineb; Trithion was used alone, and at half strength with half-strength Zineb; and DN was used with Zineb. These were compared with wettable sulfur and Zineb only. At the time of application, during the last week of December, there was a 65% rust mite infestation over the block. All sprays gave excellent rust mite control and, as late as February 25th, very few mites were present. No additional counts were made until the 20th of May. At that time, rust mite populations were increasing in all plots, and at that date only DN-Zineb showed a relatively low rust mite population. There was a tendency to have fewer rust mites where Zineb was used rather than wettable sulfur, and Kelthane showed some evidence of being better than the Tedion or the Trithion combinations. These results are of little consequence, however. All materials gave satisfactory commercial control and, since post-bloom sprays should have been applied in April, all sprays would have been completely satisfactory from the standpoint of initial reduction and length of control. The Trithion-Zineb combination is of some interest in view of the fact that there is some evidence that, at the recommended dosage for Trithion, rust mite control is no better than with sulfur, and initial red spider control often is better than required. This combination is lower in cost and apparently offers better length of rust mite control.

The Zineb recommendations, as they are given by the research organizations of the State, are usually stated in terms of pounds per 100 gallons with the suggestion that an application comparable to a scalicide spray be made. As previously reported, this organization has had excellent results with Zineb when applied at speeds in excess of 2 miles per hour with a Speed Sprayer, and our recommendations have been based primarily in terms of pounds of Zineb to be applied per acre. Neither the optimum speed of application nor the optimum rate of Zineb has been adequately determined under our circumstances. In order to get some information on this, experiments were run in 1959 on 13 and 14-year-old orange trees to study the amount of Zineb required per acre, or per tree, to accomplish satisfactory results.

Two experiments were made in the spring; one with combinations of Zineb and wettable sulfur and the other with Zineb only. Results of these are presented in Tables 2 and 3. Although rust mite counts were made

in both experiments between the time of the application and the dates which are shown in the tables, rust mite populations were so low during those periods as to be of no significance.

On this size tree, the practice in the field has been to use 3 pounds of Zineb per 65 trees or on one 1320-foot row across 40 acres. In the Zineb experiment dosages were varied from as low as 2 pounds to as high as 4 pounds per 65 trees, and were applied on both Valencia and Jaffa oranges

TABLE 2.—Per Cent of Rust Mites Found on June 12 in 80 Acres of 13-Year-Old Valencia and Jaffa Oranges after Differential Rates of Zineb were Applied on April 8, 1959.

Lbs. Zineb per 65 Trees	% Rust Mites		
	Valencia	Jaffa	Avg.
2	3	10	6
2½	3	3	3
3	0	8	4
3½	0	3	1
4	0	3	1

TABLE 3.—Per Cent Rust Mites Found on Two Dates on 14-Year-Old Valencia Trees after Differential Rates of Wettable Sulfur and Zineb were Applied on April 9, 1959.

Lbs. per 65 Trees		% Rust Mites	
Zineb	Wet. Sul.	June 12	July 9
0	33	14	53
½	33	26	48
5/6	33	13	27
1⅓	17	8	21
1⅔	17	8	18
2½	0	8	10
3⅓	0	3	7

TABLE 4.—Per Cent Rust Mites Found on August 27, 1959, on 13-Year-Old Valencia Oranges after Differential Treatments of Zineb Were Applied on July 10, 1959.

Lbs. Zineb per 65 Trees	% Rust Mites		
	Block 18	Block 21	Avg.
2	70*	16	16
2½	80*	7	7
3	3	7	5
3½	3	4	4
4	1	3	2

* Counts made on Aug. 12 and plots resprayed with same rate of Zineb. Not included in avg.

by a Speed Sprayer driven at 2½ miles per hour. All treatments were in duplicate. It will be noted that, during the period from the time of application on April 8th until the time that the summer scalicide was made shortly after June 12th, satisfactory control was obtained in all blocks, but there was a tendency for a few more mites to be found on the lower rates.

The companion experiment which tested combinations of Zineb and wettable sulfur is shown in Table 3. Here, the scalicide was delayed until July, and higher rust mite infestations occurred. The results are suggestive that the most important factor was the amount of Zineb, but more results are essential for proper evaluation. Control was generally satisfactory until mid-June, but there were too many mites by early July in the lower Zineb levels. Although control with wettable sulfur-Zineb combinations was still satisfactory in mid-June in this experiment and they represent a means of saving money in the post-bloom application, the results here as well as in field trials, are suggestive that control should not be expected to be as long as with full strength Zineb sprays. However, Zineb-sulfur combinations may be satisfactory if it be anticipated that an early scalicide spray can be applied.

In July of 1959, another Zineb rate experiment was set up in two 40-acre blocks of 13-year-old Valencia oranges. These were applied in combination with oil and parathion by a Model 40 Speed Sprayer driven double-headed at 1 mile per hour. All plots were in quadruplicate, and the results are shown in Table 4. In early August, the two low rates of Zineb in one of the two 40-acre blocks had entirely too many rust mites and it was necessary for them to be resprayed. The results of this experiment, as well as those shown in Tables 2 and 3, seem to indicate that rates, below 3 pounds per 65 trees of this size, are very apt to be too low. They further suggest that additional amounts of Zineb are of no particular value when low infestations are sprayed. Additional work is essential in order to work out the exact amounts that are required on a given-sized tree.

Red Spider Control

As noted above, this organization did not apply materials for red spider control in most groves during the winter of 1958-59. In those Valencia orange blocks where heaters or firewood were placed in the middles for frost protection, it was believed to be desirable to apply a miticide in November so that there would be no need for disturbing the frost protection equipment during the remainder of the winter. Both Tedion and Trithion were tried out in this manner. Results were inconclusive in view of the fact that mites did not develop either on the sprayed blocks or in unsprayed oranges which were adjacent and under similar cultural practice. Although miticides were not applied on grapefruit, six-spotted mite populations did not develop in the Spring.

Two experiments comparing levels of Tedion and Trithion were tried on 15-year-old Parson Brown oranges, and were applied in October and November. Red spiders never developed in either of these two blocks even during the relatively late spring of 1959, so that no information on dosage was obtained. Although numerous field trials were made in one 1,000-acre grove where individual 40-acre blocks were divided into two parts

with different levels of Tedion or Trithion being applied, red spiders did not develop and no information on their control was obtained.

It was noted, however, that Trithion as compared with Tedion-Zineb was not satisfactory for prolonged rust mite control at the rates used, and there were some places where an additional sulfur and/or Zineb was required for rust mite control. This was not true where Tedion-Zineb or where wettable sulfur only was applied. While some blocks were satisfactory where Trithion was used, it is suggestive that this material should not be considered as a primary control for rust mites if control is desired from early November until post-bloom time. It will give satisfactory results for a shorter period, and there are many times when only a short period of control is required.

Comparison of control of red spiders was made between Kelthane, Tedion and Trithion and the results are shown in Table 1. As indicated in the table, the material was applied at approximately 2½ gallons per tree on 3-year-old Pineapple trees. The applications were made on December 26th and treatments were in triplicate. Counts were made at periodic intervals throughout the winter and spring, but no counts were made between February 25th and May 20th. By that time, purple mite populations had reached high levels in the wettable sulfur and Zineb plots; and in the DN-Zineb plots had already reached a high level and were then declining. In the other experimental treatments, populations were only beginning to increase on May 20th when an additional spray was applied. At this late date, there was very little to choose between the Kelthane, Tedion and Trithion for red spider control. It should not be concluded from these results, however, that the three materials will be comparable under the conditions of greater population stress. There were practically no citrus red mites and only a 30% Texas citrus mite infestation when the experiment started. The Texas mites were killed easily and never became a problem thereafter.

On May 20th, tree condition was graded in each plot. This was an effort to note the amount of etching, or stippling, from the result of either purple mite or Texas citrus mite feeding on the foliage. Results are shown in Table 1. The plots sprayed with wettable sulfur, Zineb, or DN-Zineb looked hungry, and the leaves were heavily etched as the result of feeding. These plots were outstanding from this standpoint and were easily noted in driving across the plots. All other treatments were in reasonably good condition. It will be noted that there is a tendency for the treatments with Zineb and a purple miticide to look just a little better than the other treatments. This perhaps is correlated with the fact that, at the time of grading, rust mite populations were somewhat lower on the Zineb treatments, and it is the opinion of the author that heavy rust mite infestations contributed to the look of malnutrition.

Discussion

It is recognized that the results recorded here are fragmentary, and in themselves are insufficient for making general recommendations for control of mites on citrus. As a result of observations in the field, it is believed that Zineb is the material of choice for the control of rust mites in the spring and summer. It may be combined with sulfur satisfactorily during

the early fall, and sulfur alone will probably be a satisfactory material during the period from mid-November through February. During the post-bloom period this organization will continue to use Zineb in all locations, but additional trials in combination with sulfur will be made at post-bloom time. Until more information concerning the prevalence of broad mites and Brevipalpus mites following the use of Zineb alone is made, this type of combination should still be considered.

For prolonged control of citrus red mite or Texas mite, results from all sources seem to indicate that Tedion is the material of choice. If this material is released by the Federal authorities, it will be the one which this organization will use in blocks where spider control is desired from October or November through the winter months, but we will continue to test other materials since prices and results may change somewhat. It is the present plan to apply Tedion on all blocks in October which are on sour orange, sweet orange or Cleopatra root stock, but bearing groves on rough lemon will receive no miticide until spider populations have built to proportions to justify such an application. Non-bearing groves may receive materials for red spider control under either of two conditions: if rust mites become prevalent and an application is indicated for this mite, or if red spiders become a problem. Materials for both spider and rust mite control will be applied in those Valencia blocks where it is undesirable to have to use any spray equipment during the period when frost protection is necessary.

Whether or not the low citrus red mite population during the winter of 1958-59 was due to weather conditions, or whether it was due to the general use of Zineb or a combination of both, cannot be ascertained at the present time. It is anticipated that the general reduction in the use of sulfur will materially reduce the necessity for applying materials for the control of citrus red mites. This offers sufficient justification to refrain from the use of any miticide until such times as populations warrant it. This means that adequate checks must be made periodically in all groves. This is considerably more economical than applying materials as a preventative spray.

Summary

The results of the use of miticides on 5,000 acres of citrus suggest that, although Zineb gives the best rust mite control, combinations with sulfur may be satisfactory in the fall, winter and spring. Experiments on dosage indicate that Zineb at the rate of 3 pounds on 65 13-year-old orange trees is a satisfactory level, that more is not indicated, and that less will not always give good results. This appears to be true whether applied at 2½ or at 1 mile per hour with a Speed Sprayer. Because of low infestations, test with miticides for the control of red spiders was generally inconclusive in 1958-59.

Acknowledgments

The author wishes to express his appreciation for cooperation from Mr. Ted Stelter, of the Rohm & Haas Company; Mr. G. H. Beanes of the General Chemical Division; Mr. Bradley Hogg of Chemical Sales; Mr. Joseph Murphy of California Spray Chemical Company, and Mr. Robert Lassiter of Lyons Fertilizer Company, for help in making counts, furnishing materials, and planning some of the experiments.

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SOME NOTES ON THE RECENTLY ENACTED FLORIDA STRUCTURAL PEST CONTROL ACT OF 1959 [1]

F. Robert Du Chanois [2]

The 37th Legislature of the State of Florida meeting in biennial session enacted the new Florida Structural Pest Control Act in June, 1959. The Act was approved by the Governor on June 19, 1959, and took effect on October 1, 1959. This Act repeals and supersedes the Florida Structural Pest Control Act of 1947, which was amended in 1955. The Florida Pest Control Association, working through its special Legislative Committeee with the assistance of the Special Assistant Attorney General, is largely responsible for instigating the newly enacted Law. This Legislative Committee composed of prominent representatives of the structural pest control industry held several public hearings to consider the new legislation and was instrumental in passage of the Law. In this discussion I will refer to the Structural Pest Control Act of 1947 as the "old law" and the Structural Pest Control Act of 1959 as the "new law."

Discussion

Certain features of the new law reflect significant changes in, additions to, or deletions from, the old law and need some comment.

Definitions. The new law defines structure as "any type of edifice or building, together with the land thereunder and within two feet thereof, together with the contents thereof, together with any patio or terrace thereof; also, that portion of land upon which work has commenced for the erection of an edifice or building; also, every railway car, box car, truck, trailer, ship, boat, airplane, common carrier, dock or wharf." The old law has no definition of this term.

The new law deletes definitions for fumigants, insecticides, rodenticides, and repellents found in the old law.

Commission. The old Structural Pest Control Board is now known in the new law as the Structural Pest Control Commission of Florida.

Enforcement. The State Board of Health is now empowered to proceed in the courts of the State by mandamus, injunction, or other actions for the enforcement of this measure or against any unauthorized person engaging in structural pest control. This feature was not clearly stated in the old law. One of the apparent salient features of the new law is its greater ease of enforceability.

Rules.[3] The State Board of Health is now required to obtain the advice of the Commission before its Rules and Regulations become effective,

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[1] A paper presented at the 42nd Annual Meeting of the Florida Entomological Society, Miami, Sept. 10-12, 1959.

[2] Entomologist, Bureau of Entomology, Florida State Board of Health, Jacksonville.

[3] Any person who violates any Structural Pest Control Rule of the State Board of Health is guilty of a misdemeanor, and upon conviction shall be punished by a fine of not more than $100.00 or by imprisonment not exceeding five days or both in the discretion of the Court having jurisdiction.

and the Commission may make written recommendations to the State Board of Health concerning Board Rules. To formulate these recommendations, the Commission may appoint a supervisory committee or may hold public hearings or may counsel with the certified operators or the Florida Pest Control Association.

INSPECTION. As in the old law the State Inspectors enforce the measure and report all violations to the Board and Commission. As all the State Board of Health Regional Entomologists are appointed as Inspectors, they can also report violations, if necessary.

LICENSES. The fee for business license and for annual renewals thereof paid to the State Board of Health, which was formerly $25.00, has been reduced to $5.00 in the new law. The difference of $20.00 is now transferred to the fee for the renewal of structural pest control certificates, so that now the fee for the latter is $25.00 payable to the Commission. This change in the recipient of the larger revenue will enable the Structural Pest Control Commission to operate more effectively and freely in carrying out the provisions of the measure and in promoting structural pest control.

In the event of death, loss of certified operator or other emergency, the new law enables any one Commissioner to issue emergency certificates or special I D cards for a period of ten days upon request of the licensee. The Commission itself may renew these for additional periods of 90 days up to a maximum of one year, as in the old law.

OCCUPATIONAL LICENSE. The new law provides that no municipality or county shall issue an occupational license to any structural pest control business coming under the provisions of the Act, unless a license has first been procured for each business location from the State Board of Health. There is no such provision in the old law.

STRUCTURAL PEST CONTROL COMMISSION OF FLORIDA. The new law gives the Commission more latitude in discharging its dues, such as meeting from time to time and from place to place and the power to establish and re-establish executive offices in any county. The Commission may also employ and at its pleasure discharge such employees as may be necessary. The Commission is enabled under the new law to obtain subpoenas through the courts for witnesses to appear before it.

CERTIFICATE. The annual renewal fee for the structural pest control certificate is now changed from $5.00 to $25.00 as referred to previously.

QUALIFICATIONS FOR CERTIFICATION. Under the new law, each applicant for certification must possess the following basic qualifications:

1. Three years as a service employee in structural pest control, one year of which must have been in this state immediately preceding application for certification.

2. A degree with advanced training or major in Entomology from a recognized college or university, together with six months practical experience in structural pest control in this state under proper supervision of a licensee.

3. Each applicant must have knowledge of practical and scientific facts of structural pest control.

In view of the power of the Commission to make necessary rules which are not inconsistent with those of the State Board of Health, it is very

probable that the Commission will relax these qualifications to require an applicant to possess either the first or the second prerequisites, in addition to passing a written examination. As the law now reads, it can be seen that the acquisition of a structural pest control certificate becomes very difficult.

SPECIAL I D CARDS. The new law differs from the old in providing for the issuance by the Commission of special I D cards in one or more categories of work to individuals who qualify under the measure. The Commission will give written examination to those who wish to qualify for these special "junior certificates." The State Board of Health will provide for privileges, duties, and limitations regarding holders of special I. D. cards in its rules.

LIENS ON REAL AND PERSONAL PROPERTY. The new law differs from the old by enabling a structural pest control licensee to enforce a lien on real and personal property for any money that shall be owing it for labor or services performed or materials furnished.

EXEMPTIONS. The new law does not apply to the use of wood preservatives used only on wood, properly pretreated timber, properly pretreated lumber, or metal shields, when used *in construction* on structures. In addition, the Act does not apply to structural pest control, other than fumigation, performed by a person upon his own individual residence *or property.*

THERMAL-AEROSOL LAW. The provisions of the Thermal-Aerosol Act of 1949 will terminate as of January 1, 1965, at which time each thermal-aerosol certificate shall become void. The holders of these certificates are entitled to apply for examination in the category of general household pest control.

GRANDFATHER CLAUSE. The new law in effect prescribes three categories of work as opposed to four in the old law, viz. termites and wood-destroying organisms, fumigation and general household pests (includes rodents).

SUMMARY

The Florida Structural Pest Control Act of 1959 would appear to be more enforceable, thus enabling the State Board of Health to fulfill its duties and responsibilities more effectively and expeditiously; it facilitates and strengthens the functions of the Structural Pest Control Commission; and it liberalizes certain provisions of the law in certain respects favoring the structural pest control industry itself. It would surely seem to be the duty and obligation of every Entomologist, irrespective of specialization, to encourage, assist, and counsel the structural pest control industry to the end that it may some day become a universally self-regulating segment of commerce. The services offered by the pest control industry are based upon fundamental principles of applied entomology. The intrinsic value of applied entomology to man in modern day-to-day living should stand out, in part, in bold relief in the work performed by the pest control operator. By the same token the pest control industry is soundly indebted to the science of Entomology for its origin and present stature and has an obligation to support the science in every way possible.

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